

REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully reviewing this application.

Disposition of Claims

Claims 1-26 and 33-39 are pending in the application. Claims 1, 2, 5-11, 16-19, 21, 22, 26 and 33 are independent. The remaining claims depend, directly or indirectly, from claims 2, 3, 9-11, 17-19, and 22.

Amendments

Claims 1, 2, 5-11, and 16-19 have been amended to clarify the invention recited. No new matter has been introduced by these amendments.

Rejection(s) under 35 U.S.C § 103

Claims 1-26 and 33-39 stand rejected under 35 USC § 103(a) as being unpatentable over Monson et al. ('491) in view of Bach et al. Claims 1, 2, 5-11, and 16-19 have been amended in this reply to clarify the recited invention. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

The present invention relates to apparatus and methods for measuring soil properties. A method in accordance with embodiments of the invention uses a soil measuring apparatus to acquire soil property data, which are then inputted into a soil model to compute the soil properties. The soil model is determined based on information related to the soil type and the water content of the measurement site. In addition, the data to be inputted into the model may be acquired based on measurement conditions determined from the soil type and/or the water content of the measurement site. (Specification, p. 5, lines 5-14).

A soil measuring apparatus suitable for use with embodiments of the invention may comprise a detecting means and a processing means. The processing means is for calculating the soil properties based on a model that is selected based on the information related to the soil type

and the water content of the measurement site. (Specification, p. 5, lines 15-25).

An apparatus in accordance with embodiments of the invention may further comprise a *soil measurement assisting device*. The soil measurement assisting device may comprise a storage means and a determining means. In particular embodiments, the storage means is for storing, for example, soil measurement data, models for calculating soil properties, and measurement conditions. Further, the determining means is for (i) acquiring information related to the soil type and the water content of the measurement site, (ii) accessing the storage means *to determine, based on information related to the soil type and the water content of the measurement site, a suitable soil model and suitable measurement conditions* for further data measurements, and (iii) outputting the model and the measurement conditions to the main soil measurement apparatus. (Specification, p. 8, line 18 – p. 9, line 3).

The measurement assisting device may be used in a soil measurement assisting method. A soil measurement assisting method in accordance with embodiments of the invention may involve the following steps: (i) preparing the storage means for storing soil measurement data, (ii) acquiring preliminary measurement data related to the soil type and/or water content of the measurement site, (iii) accessing the storage means *to determine a suitable soil model and/or measurement conditions (for further measurements) based on the soil type and the water content* from the preliminary measurement, and (iv) outputting the soil model and/or the measurement conditions to the main measuring apparatus. (Specification, p. 8, lines 3-17).

As noted in the present specification, the soil type and the water content have a significant influence on the soil measurement data, and hence the soil model. If the soil type and the water content are treated like other soil parameters and a general soil model is used to derive soil properties, the parameters thus obtained may not be accurate.

Therefore, according to embodiments of the invention, data related to soil type and water content and data related to other soil properties are used in a hierarchical (two-level) manner. First, the soil type and the water content are used as “higher-level” parameters to design measurement conditions (for further measurement) and/or to select a proper soil model (for deriving the soil properties). By using the information of the soil type and the water content to design measurement conditions, the measurement data will be more reliable and can produce more accurate soil properties. Similarly, by using the soil type and the water content to determine a proper soil model for the calculation, the resultant soil property estimates will be more accurate.

In accordance with embodiments of the invention, information related to soil types and water contents are not treated as general parameters in the soil model. Instead, they are used as higher level parameters to determine soil models. Accordingly, in a database, information related to the soil types and the water contents are stored at the same level as the soil models – same hierarchical fields in a record.

All independent claims recite embodiments related to the hierarchical use of the soil type and the water content parameters to determine a proper soil model, or use the soil type and/or water content information to determine measurement conditions for further measurements.

Claim 1

Claim 1 includes the following limitations: (i) obtaining information related a soil type and a water content of a measurement site; (ii) determining a model based on the soil type and the water content; (iii) acquiring measurement data using a soil sensor based on information related to at least one parameter selected from the soil type and the water content; and (iv) calculating the properties of the soil using said acquired measurement data in the model.

As noted in the present application, p. 4, lines 4-8, a method of the invention may use soil type and/or water content information, which may be available from a previous measurement, to determine a soil model and to determine further measurement conditions. In some embodiments, the soil type and the water content may be determined as preliminary measurements (e.g., claims 6 and 7) in performing the method.

The step of “obtaining . . .” in the amended claim 1 may obtain the previously determined information related to the soil type and water content. Once the soil type and water content of the measurement site are available, these parameters may be used to determine a model. Similarly, the soil type and/or water content may be used to determine measurement conditions for further measurements to obtain data to be analyzed in the model. Note that the soil type and water content are “higher-level” parameters and are typically not included in the further measurement data that are to be inputted into the model. Further note that because the soil type and the water content are treated as “higher-level” parameters, they can be independently used in different ways to determine the model and to determine further measurement conditions. That is, the soil type and the water content are “external” parameters used to guide the selection of a soil model and to guide the data measurements; it is unnecessary that these two parameters be used in the same way to

guide the selection of the model and to guide the data acquisition.

Neither Monson et al. nor Bach et al. discloses using the soil type and water content as “higher-level” parameters to select model and to determine measurement conditions as recited in the amended claim 1.

Other Independent Claims

Similarly, independent claims 2, 5-11, and 17-19 each include one or both of the following limitations: (i) *acquiring measurement data . . . based on information related to a soil type and a water content of a measurement site;* and (ii) *determining a model (and/or measurement conditions) . . . determined based on the information related to the soil type and the water content.*

Independent claim 16 recites a method in which a *preliminary measurement data* related to optical properties of the measurement site *is used to determine a preliminary soil model.* A second set of measurement data related to chemical components of the soil is obtained and used to modify the preliminary soil model. This method also uses measurement data (optical and chemical component data) in a hierarchical manner to determine a model for deriving soil properties.

Independent claim 21 relates to a soil measuring apparatus that includes “*a soil measurement assisting device* that determines . . . a soil type of the measurement site, *a model . . . based on information related to a water content of the soil,* and measurement conditions for acquiring further measurement data.”

Independent claims 22 and 26 relate to a recording medium storing information that includes “*a soil type, information related to a water content of a soil, a model for calculating soil properties, and soil measurement data correlated with measurement conditions to be imputed into the model.*” The information related to the soil types and the water contents are stored at the same level as the models, rather than as parameters inside the models, so that these parameters may be used to determine a suitable soil model.

Independent claim 33 relates to a soil model database control system, “wherein the soil model database stores one parameter selected from a soil type, information related to water contents of a soil, soil measurement data for calculating soil properties, and soil correlation information.” Again, the information related to soil types and the water contents is treated as higher level parameters.

In contrast, Monson et al. discloses a soil analysis system for determining various soil

characteristics. Various soil characteristics may include moisture content, organic matter content and the presence of nitrogen phosphate, potassium and other elements. (Abstract). Like other prior art soil characterization systems, the system of Monson et al. does not disclose *determining a model based on the soil type and the water content, or acquiring measurement data based on information related to a soil type or a water content.*

Bach et al. discloses methods using modeling to derive water contents on the surface of the soil and in the soil. (Abstract). The methods of Bach et al. aim at providing accurate estimates of water contents from reflectance data. They use a general model and measurement data to extract water content information. Extraction of the water content is the *aim*. This is in contrast to the present invention, in which the water content, together with the soil type, is a *means* for determining better measurement conditions and a better soil model. Thus, Bach et al. fails to disclose or suggest *using the soil type and the water content to design measurement conditions or to select a suitable soil model.*

Because neither Monson et al. nor Bach et al. teaches or suggests using or treating the soil type and the water content as high-level (hierarchical) parameters, these references, whether considered separately or in combination, cannot anticipate or render obvious the invention cited in independent claims 1, 2, 5-11, 16-19, 21, 22, and 33. Therefore, these independent claims are patentable over these prior art references, and dependent claims are patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 04730.003001)

Respectfully submitted,

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